these aquatic insects are but little known in this country, and Professor Vorhies has made a good start in describing 18 species that he reared to adult. Six species are considered new. The figures show the structural characters of the larvæ and also of some of the adults.

THE larvæ of gnats of the genus *Chironomus* have often been studied by naturalists, but not the least interesting is a posthumous paper by A. T. Mundy.[7] The part on the anatomy of the head seems to be particularly well done. There are detailed accounts of the making of the larval tubes, and a summary of the habits of allied *Chironomus* larvæ.

THE largest volume so far published on the "Collections Zoologiques du Baron Edm. de Selys Longchamps" is Fascicle VIII., a monograph of the Ascalaphidæ[8] by H. van der Weele. The de Selys collection is particularly rich in this family, possessing many types of Latreille and Rambur. About 200 species are now known, arranged in 50 genera, and the author has had peculiar facilities in studying specimens in many museums and collections. To the two former subfamilies, Schizophthalminæ and Holophthalminæ, he adds a new subfamily, Protascalaphinæ, for *Stilbopteryx* and *Albardia*.

IN this same series René Martin has published two fascicles (XIX., XX.) on the dragon-flies of the group Æschnines, completing the account of this family. There are about 185 species in 28 genera, mostly belonging to *Æschna* or *Gynacantha*. Many species are described as new, especially from Mr. Martin's collection. NATHAN BANKS

SPECIAL ARTICLES

AN EXPERIMENT IN MUSICAL ESTHETICS

IN the field of psychology, few subjects offer as many difficulties to the investigator as that of esthetics, and in the realm of esthetics, few topics are more obscure than those that relate to the art of music.

Problems in musical esthetics, by their very nature, can not be adequately understood without taking account of both their psychological and their purely musical aspects. Unfortunately for the solution of such problems, however, the psychologist and the musician, in too many instances, not only fail to cooperate in their studies, but even lack an appreciative and sympathetic understanding of each other's methods and conclusions. We are much in need of two-handed men, equipped in both directions—or else, of intimate collaboration between the investigators in the separate fields.

Largely because of a lack of just such collaboration, the subject of musical dissonance has been invested with an atmosphere of uncertainty and confusion, in the minds of both psychologists, estheticians and musicians. The difficulties inhere, particularly, in ambiguous definitions of the word *dissonance* itself—definitions to which we have become so accustomed that, as a rule, we fail to notice their inadequacy. Among various uncertain and shifting meanings assigned to the term, two fairly defined conceptions present themselves: (1) a dissonance is a combination of simultaneous tones that *sounds harsh;* (2) a dissonance is a combination of simultaneous tones that *requires resolution* (*i. e.,* creates a feeling of unrest, removable only when the given combination of tones is followed by a more or less prescribed other combination). Either of these definitions is feasible and adequate, in itself; the confusion arises from the fact that, even among men usually careful of their terminology, the word *dissonance* is employed, first in the one sense and then in the other.

It seems to the present writer that the term *dissonance* will be both more nearly exact in its meaning, and more useful to the musician, if it be defined, simply, as a combination of simultaneous tones that *sounds harsh* (psychologically, the sensation produced by such a combination). Under the terms of this definition, the only dissonant intervals are those known as *seconds* and *sevenths;* and the only

[7] "The Anatomy, Habits and Psychology of *Chironomus pusio* Meigen (the Early Stages)," Leicester, England, 1909, pp. 56, 8 plates.

[8] "Ascalaphiden," Monographisch Bearbeitet, 326 pp., 254 figs., 2 col. plates, Brussels, 1909.

dissonant chords, those in which such intervals occur. This definition, it may be added, has been in use in the writer's classes for several years, with satisfactory results.

Objection to this position was recently made, on the ground that, in our experience, there is not so clear a discrimination, as is implied, between *seconds* and *sevenths,* on the one hand, and all the remaining intervals, on the other. Specifically, the claim was advanced that the interval of an *augmented fourth,* traditionally known as a dissonance, sounds equally harsh with the *seconds* and the *sevenths.*

In order to test the truth of these opposite opinions, the writer recently decided to conduct an experiment in which the reactions to various intervals might be determined in the case of persons who, though untrained in musical theory, are yet sensitive to musical effects. A collegiate class was selected for the experiment, a class of music-lovers ignorant of the technique of musical structure.

In order that the validity of the tests might not be affected by any preconceived notions on the part of the performer, the playing of the various intervals employed was entrusted to an assistant, who was kept in total ignorance of the nature and purpose of the experiment. The intervals were played on a grand pianoforte of good quality, and the assistant was instructed, as far as possible, to employ the same touch and intensity throughout the tests. Each interval was played from a manuscript copy; and, after a pause of perhaps two seconds, repeated. Before the following interval was performed, ten seconds, approximately, were allowed to elapse, during which the number of the coming test was announced; it was hoped that, in this way, the various combinations would be isolated. The order of presentation had been previously determined, by lot. Every care was exercised to make the experiment scientifically accurate; so that the results, it is believed, are, in every way, trustworthy.

The following explanation was written on the blackboard before the class: "Assume that all musical intervals (an interval is a combination of two simultaneous tones differing, more or less, in pitch) can be classified in two groups, which we shall call Group X and Group Y. Let Group X include intervals whose sound is *smooth;* let Group Y include intervals whose sound is *harsh.* Three intervals will now be played representing Group X; and afterward three intervals representing Group Y." At this point the assistant was called from an adjoining room, and requested to play the following intervals representing Group X: a *major third,* a *major sixth* and a *minor third.* Afterward, he was requested to play the following intervals representing Group Y: a *major seventh,* a *major second* and a *minor second.*

The actual tests were then presented to the class. These consisted of a series of twenty-two intervals, in which each combination from a *minor second* to a *major seventh* was included twice. The students were requested to record, in writing, the name of the group (X or Y) to which, in their judgment, each interval belonged.

Thirty-five students replied, affording seventy tests in the case of each interval. The results are collated in the following table:

	Smooth	Harsh
Minor second	0	70
Major second	5	65
Minor third	67	3
Major third	68	2
Perfect fourth	56	14
Augmented fourth	68	2
Perfect fifth	53	17
Minor sixth	68	2
Major sixth	69	1
Minor seventh	4	66
Major seventh	2	68

The significant features of the replies are:

1. The almost unanimous verdict that *seconds* and *sevenths* are harsh, whereas all other intervals are smooth.

2. The large number of dissenters from the prevailing opinion that *perfect fourths* and *perfect fifths* are smooth.

3. The almost unanimous verdict that the *augmented fourth* (the same, on the pianoforte, as the *diminished fifth*) is smooth—just as smooth as the *thirds* and *sixths,* and much

more smooth than the *perfect fourth* or the *perfect fifth.*

It is believed that these results are of significance, in connection with a number of problems in the field of musical esthetics.

The experiment described above has stimulated similar tests in other institutions. In Wellesley College, under the direction of Professor H. C. Macdougall, experiments were made by Miss Hetty S. Wheeler, in classes yielding 204 replies. Owing to a typographical error, 306 replies were received in the case of the *major sixth,* and only 102 in the case of the *perfect fifth.* The results from Wellesley College, which are very similar to those described above, are contained in the following table:

	Smooth	Harsh
Minor second	0	204
Major second	14	190
Minor third	199	5
Major third	204	0
Perfect fourth	139	65
Augmented fourth	166	38
Perfect fifth	72	30
Minor sixth	202	2
Major sixth	289	17
Minor seventh	14	190
Major seventh	0	204

Professor W. A. White, of Syracuse University, also, made a similar experiment, with somewhat different results. Inasmuch, however, as his tests were made on classes of students more or less advanced in the study of harmony, many of whom recognized the intervals as they were played, the experiment is obviously not comparable with those previously mentioned.

LEONARD B. MCWHOOD
COLUMBIA UNIVERSITY

THE FORTIETH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY. II

SECTION OF PHARMACEUTICAL CHEMISTRY

A. B. Stevens, chairman

A New Form of Separator: C. E. PARKER.

The "shaking out" method of extraction is difficult or impracticable with solutions which have marked tendency to emulsify. A separator of flat form is described, in which, when in a horizontal position, the immiscible liquids spread out in broad thin layers in contact with each other. By gently tilting the separator by manual or mechanical means the layers float about without mixing and the extraction of soluble material is readily effected. The operation may be called "floating out" instead of "shaking out." On placing the separator in erect position the lower liquid may be drawn off through a stopcock as usual.

Investigations of Glacial Phosphoric Acid: L. F. KEBLER and B. HERSTEIN.

It has been known for many years that the composition of glacial phosphoric acid is far from uniform, and its use so far as a chemical reagent and for the manufacture of medicinal products is of questionable utility. Furthermore, solutions of glacial phosphoric acid are comparatively unstable, the metaphosphoric acid reverting to the pyro and the pyro gradually to the ortho. The object of this contribution is: (1) to give a method for determining the respective amounts of the various hydrates of phosphorus pentoxid present in ordinary glacial phosphoric acid; (2) to determine the rapidity of reversion to the higher forms of hydration; (3) to show the undesirability of using it either as a reagent or for preparing medicines.

The Purity of Glycerin: H. C. FULLER and L. F. KEBLER.

In this paper is discussed results of investigations of the various brands of glycerin furnished by manufacturers knowing the object and purpose of such samples. The chief objects of the examinations were: (1) To determine whether or not the tests prescribed by the Pharmacopœia were unduly rigid. (2) Whether or not any glycerin was available which when used in making up Haines's solution would not be instrumental in causing a reduction of the copper.

Note on the Determination of Morphin: C. E. PARKER.

The use of a solution of thymol in chloroform (or other volatile solvent) for extracting morphin from solutions, especially those containing glycerol and small amounts of morphin, is described. Opium preparations are first freed from alcohol and then extracted with chloroform, first in acid or neutral solution and again after addition of excess of potassium hydroxid. The solution is then acidified, excess of sodium bicarbonate added and extracted with the thymol solution. The thymol solution is shaken out with one per cent. hydrochloric acid and the latter evaporated. The